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AT&T

Richard N. Clarke

Room 5462C2
295 North Maple Avenue
Basking Ridge, NJ 07920
908-221-8685

January 6, 1998

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M. St., NW, Room 222
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

RE: Ex Parte Presentation – Proxy Cost Models
CC Docket No. 96-45

Dear Ms. Salas:

On January 5, 1998, AT&T and MCI (the Hatfield Model Sponsors or "HMS") met with Anthony Bush, Brian Clopton, Abdel Eqab, Chuck Keller, Bob Loube, Bill Sharkey, Richard Smith, Whitey Thayer and Natalie Wales of the Universal Service Branch of the Common Carrier Bureau in regards to the staff's examination of cost models for universal service in CC Docket Nos. 96-45 and 97-160. The HMS were represented by Rich Clarke and Cathy Petzinger of AT&T, Chris Frentrup of MCI, Robert Mercer of HAI Consulting, John Donovan of Telecom Visions and Brian Pitkin of Klick, Kent and Allen.

The purpose of this meeting. was to provide the Commission staff with an evaluation of the performance of the HM 5.0 vis à vis the BCPM3 at modeling the engineering of a local telephone network. This analysis demonstrates that in every significant regard, the HM 5.0 more accurately engineers and costs local networks. In particular, the BCPM3 is shown to do an incomplete and rudimentary job of modeling the actual forward-looking, efficiency-seeking decisions of network engineers. As a result, its cost estimates both imprecise and overstated relative to the more sophisticated and accurate estimates provided by the HM 5.0.

The comments provided here are based on the HMS' best understanding of the BCPM3's network engineering. This understanding is based primarily on the rather sketchy documentation that has been provided by the BCPM3 sponsors about their model's operations. Because the BCPM3 now performs massive amounts of its local network engineering in preprocessing steps that have been effectively sealed from reasonable public review, it has been impossible to confirm the answers to many questions about the BCPM3's operations. It is not the HMS' intention to misrepresent the actual operations of the BCPM3. If it is demonstrated that the BCPM3 does not perform in the fashion suggested in these comments, the HMS would be happy to reevaluate their concerns.

Two copies of this Notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(2) of the Commission's rules. Because of the late hour of this meeting, this notice is being filed the following business day.

Sincerely,

Richard N. Clarke / ha

Richard N. Clarke

Attachments

cc: Sheryl Todd
Anthony Bush
Brian Clopton
Abdel Eqab
Chuck Keller
Mark Kennet
Bob Loube
Bill Sharkey
Richard Smith
Whitey Thayer
Brad Wimmer
Natalie Wales

Scorecard

Modeling the Local Network:

Hatfield 5.0 vs. BCPM3

AT&T and MCI

January 5, 1998

1. DISTRIBUTION

1.1. Cable Configurations

See attached sheets

1.2. Lot Dimensions

Issue: Lot dimensions directly affect facility investment for telecommunications, as well as investment in roads, sidewalks, and grass medians. A model must make assumptions regarding lot sizes and shapes.

BCPM3: Assumes square lots. After grids are formed, BCPM3 assumes an occupied land area based on 500 foot swaths along each side of roads, and then divides that land area into equal sized square lots. Since the area occupied by streets, grass medians and sidewalks is included in the total occupied land area being modeled, this area is included in BCPM3's assumed square lot for each customer.

HM 5.0: Assumes rectangular lots with a lot depth twice as deep as the frontage width (side facing the street). The HM 5.0 cluster area being modeled is by default rectangular, based on the calculated height to width aspect ratio. The resulting occupied land area is then divided into equal sized lots that are twice as deep as wide. Like BCPM3, the area occupied by streets, grass medians, and sidewalks is included in the total occupied land area being modeled, and is included in each customer's assumed rectangular lot.

Discussion: Lot shapes are determined by property developers. General observation indicates that, except for corner lots, most are rectangular, with the street frontage narrower than the lot depth. This is the most efficient layout for developers for whom roads and sidewalks are costly, non-revenue producing assets. The least efficient plot layout is one in which the street frontage is wider than the plot depth. Such a configuration increases a developer's pavement costs, reduces each homeowner's land area, and generates shallow front and rear yards -- which are not normally desired by consumers. Indeed, a limited sample of plot plans indicates that when the area of streets, grass medians, and sidewalks are included, the average lot depth to width is a ratio of 2.1:1. This configuration is illustrated in Exhibits 3 and 4.

By modeling square plots that include road, grass median, and sidewalk area, BCPM3 has effectively modeled consumer lots that are rectangular, but rotated in the opposite direction from what is desired by developers and homeowners. Exhibit 5 illustrates this condition. In doing so, the BCPM3 assumes plot configurations that are contrary to what is observed, because builders lay out developments to minimize road and sidewalk costs, and to maximize customers' lawn area. Thus, the BCPM3 model overstates facility costs and cable lengths because of its lot dimensions.

Score: BCPM3's methodology is contrary to the economics of property development, and artificially inflates costs. HM 5.0 creates a construct that mirrors what is natural to developers.

1.3. Efficient Choice of Structure Type

Issue: Telecommunications plant structure is typically chosen to minimize route costs, subject to various zoning, security and esthetic constraints. Models should recognize that local conditions may present OSP engineers with varying structure costs, and that the structure selected in these localities should be consistent with cost-minimization.

BCPM3: Permits the user to specify structure placement percentages that vary by density zone, and by normal, soft rock and hard rock conditions.

HM 5.0: Permits the user to specify initial default structure placement percentages that vary by density zone. But, then examines the life-cycle cost ratio between buried and aerial structure in the specific location, relative to this cost ratio under "normal" conditions.[1] The model then "shifts" a portion of the less economic structure for these local conditions, to the more economic structure. The amount of structure potentially shifted, and the sensitivity of this shift to varying cost conditions are user-adjustable inputs.

Discussion: The BCPM3 recognizes only terrain placement cost differences as drivers of structure shifts – and then only on a three-level basis. In contrast, the HM 5.0 recognizes all of the engineering and cost factors that can make one type of structure more economic than another. These include local terrain placement costs (which in the HM 5.0 vary by more than three discrete levels), local labor costs, local water table, depreciation, maintenance and potential for structure sharing.

[1] Life-cycle costs include placement costs, maintenance and repair costs, capital carrying costs, and are adjusted to reflect the amount of shared use this structure type can offer to cooperating utilities.

Score: Because the HM 5.0 recognizes all of the cost drivers that would be considered by an optimizing OSP engineer, its methodology is superior to the BCPM3's three-level choice.

2. FEEDER STRUCTURE

2.1. Main Feeder Steering

Issue: How do the models direct the main feeder to each distribution area? Is the routing on a right angle basis, or some adaptive steering mechanism. Are the direction algorithms sound from a network engineering standpoint, and does the chosen algorithm result in a cost-efficient routing?

BCPM3: Extends main feeder in cardinal (N/S/E/W) directions out 10,000 feet from the wire center. Then, directs the main feeder on a beeline basis towards the population centroid of the quadrant. If the center 30° of the quadrant contains less than 1/3 of the quadrant's lines, the main feeder is split into two main feeders – each directed to the population centroid of their half quadrant. Feeder cable lengths calculated by this steering algorithm are compared with feeder lengths calculated via right angle routing. BCPM3's documentation states that it selects the routing methodology that provides for the shortest length of feeder cable. (BCPM, Release 3.0 Model Methodology, December 11, 1997, Section 6.3, pp. 35-37). All calculations are performed in BCPM3's pre-processing stage and are not user adjustable, or easily verified. Model input data available for public view provide only total cable lengths determined by the preprocessor's selected algorithm.

HM 5.0: Two, user-adjustable options are offered. The default is for main feeder to extend in cardinal (N/S/E/W) directions from the wire center. In the alternative, the user may request that main feeder be steered toward the main cluster centroid of the quadrant – with more distant main cluster locations weighted more heavily than close in main cluster locations. If the main feeder steering is selected, the user may choose to apply a user-adjustable route-air mileage multiplier to the "steered" route distances.

Discussion: The BCPM3 method for determining feeder design is poorly documented, and appears to be suboptimal. By directing steered main feeders to the population centroid of the quadrant (or quadrant half if the route is split), and choosing between steered or right angle routing based on total cable lengths, BCPM3 misguidedly focuses on cable lengths (i.e., pair feet) without regard to structure distance. This is not a sound design (see

Exhibit 6) – especially for serving grids beyond 10,000 feet from the wire center which are almost certainly on fiber. This is because structure costs for serving these distant grids are almost certainly more significant than their fiber cable costs. Thus, the BCPM3 steering algorithm appears not to represent an engineer's optimal routing decision. Thus, its introduction as an alternative to right angle routing may still not permit any real economies from feeder steering to be modeled. Furthermore, it is problematic that the BCPM3 steering algorithm permits no route-air multiplier, and its operation is hidden from view in a preprocessing module.

The HM 5.0 steering algorithm recognizes that structure (rather than cable cross-section) is the main driver of total feeder costs. Thus, it chooses an overall angular feeder offset by weighting each cluster's angular offset by its distance from the wire center, and not its population. Furthermore, use of this algorithm is at the user's discretion, and a user-adjustable route-air multiplier can be applied.

Score: Structure cost is considerably higher than cable or wire costs. HM 5.0's main feeder steering algorithm seeks appropriately to minimize the amount of structure distance, which drives most of the main feeder cost -- in contrast to BCPM3's inappropriate minimization of cable lengths. Thus, the optional HM 5.0 steering algorithm is likely to provide a more realistic and efficient alternative to right angle routing.

2.2. Sub-Feeder Design

Issue: How do the models direct the subfeeders from each main feeder to their distribution areas? Are subfeeder spurs directed off of the main feeder in perpendicular fashion, or are they angled?

BCPM3: Extends subfeeder from the main feeder towards a road centroid of an aggregated grid only in a cardinal (N/S/E/W) direction – regardless of whether the feeder is angled. Subfeeders are "shared" with grids that are stacked N/S or E/W based on BCPM3's grid cookie cutter design at 1/200th of a degree intervals (BCPM, Release 3.0 Model Methodology, December 11, 1997, Section 6.4, pp. 37-38). The red lines in Exhibit 7 depict BCPM feeder and subfeeder design.

HM 5.0: Extends subfeeder from main feeder towards main clusters in a perpendicular design. The blue dashed lines in Exhibit 7 depict HM 5.0 feeder and subfeeder design.

Discussion: By BCPM3's restricting of subfeeders to run N/S or E/W regardless of whether the main feeder is angled, subfeeder may emanate in a non-perpendicular fashion from the main feeder – and run a considerable distance in tandem with the main feeder, before reaching its distribution grid (see. Exhibit 8). This may result in large amounts of duplicative structure and cable costs. Because the HM 5.0 always extends subfeeders perpendicularly from the main feeder, structure costs are kept to a minimum.

Score: BCPM subfeeder design generates longer subfeeder distances -- which lead to an overstatement of costs. HM 5.0 perpendicular subfeeder routing is more efficient.

2.3. Choice of Feeder Technology

Issue: Feeder may be analog copper or digital fiber. Models must select technology that minimizes costs given a service quality level.

BCPM3: Uses copper feeder if total feeder plus distribution length is less than a user-adjustable 12,000 feet. Otherwise specifies fiber. Also, will specify fiber if a serving area would require use of a cable larger than 4200 pairs in size.

HM 5.0: Uses fiber feeder if ever: (a) feeder length exceeds 9000 feet; or (b) total feeder plus distribution length would exceed 18,000 feet; or (c) main cluster serves outlier clusters: or (d) a life-cycle analysis of copper versus fiber costs shows that fiber is more economical on that route.

Discussion: BCPM3 methodology is rudimentary, and does not examine the specific economics of the technology decision. HM 5.0 decision is more sophisticated, and truly optimizes technology choice.

Score: HM 5.0 is superior.

3. SERVING AREA SIZE AND DLC ISSUES

3.1. Sizing Serving Areas by Line Counts

Issue: Serving areas are sized to meet aggregate demand for transport via feeder facilities back to a wire center. Engineering constraints apply to serving area sizing, and should be followed based on forward looking technologies.

BCPM3: Preprocessing stage seeks to break grids into smaller serving areas if the serving area would otherwise contain over 1,000 lines. Does this by breaking grids into four sections whenever the 1,000 line threshold is reached. States that its purpose is to minimize distribution plant[2]. Also states that the maximum size DLC RT cabinet available is 1344 lines.

HM 5.0: Aggregates to the maximum extent demand from distribution cables to economically transport as much traffic as is feasible over feeder facilities to the wire center. Permits SAI sizes up to 7200 pairs (feeder pairs plus distribution pairs). Permits up to 90% of 2016 lines to be served in an outdoor DLC remote terminal cabinet (1800 lines).

Discussion: The BCPM3 appears to limit artificially the maximum size of serving areas. The BCPM3 Sponsors' belief in a 1000 line maximum sized serving area appears to be based on a mistaken belief that SAIs are unavailable in sizes of over 2700 pairs, or that right of way could not be obtained for SAIs larger than 3600 pairs. Because 7200 pair SAIs are available in configurations that resemble double-sided 3600 pair SAIs, it appears that BCPM3's 1000 line limitation is specious. By placing excessive numbers of undersized SAIs, per line costs are elevated.

Similarly, DLC RT cabinets in sizes up to and including a 2016 line capability are available – even for the specific large DLC modeled by BCPM3: the DSC Litespan-2000. DSC engineering practices document the fact that 2016 lines can be supported within this product line.

It is also uneconomic for the BCPM3 to divide a serving area into four sections if a lines threshold is exceeded, rather than two. In contrast, when the HM 5.0 encounters a cluster in excess of 1800 lines, it places extra DLCs at the cluster's centroid to continue to serve the cluster efficiently as a whole – and to save on repetitive site acquisition and preparation expenses. See Exhibit 10.

In all events, the BCPM3 philosophy of minimizing distribution plant is anti-economic. Economies of scale can be achieved by aggregating demand, especially given the virtually unlimited bandwidth capabilities of fiber transport. If the BCPM3 strategy were the correct one, it would suggest that taking fiber all the way to the to the home would be the most

[2] Joint Comments of BellSouth Corporation, BellSouth Communications, Inc., US West, Inc., and Sprint Local Telephone Companies to FNPRM Sections III.C.1 before the Federal Communications Commission, September 2, 1997, Pg.5.

economical OSP configuration. This does not comport with the experience of most LECs.

Score: HM 5.0 correctly aggregates demand into adequately sized feeder facilities, based on available forward looking technology. It is superior to BCPM3 engineering that unnecessarily breaks up areas into inefficiently small serving areas.

3.2. Ensuring Efficient Support for Advanced Services

Issue: *"The loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services."*[3]

BCPM3: Appears to assume that adherence to the CSA concept established by Bellcore in 1980 is necessary to meet the "advanced services" criteria established in the FCC and Joint Board recommendations. BCPM3 proponents also allege a "900 ohm rule" for CSA design and claim that maximum permitted copper loop loss for POTS is 8.0 dB. As a result, the BCPM3 Sponsors state that these constraints require the use of REUVG cards in DSC DLC.

HM 5.0: Uses all applicable forward looking engineering guidelines and design specifications to design efficient facilities that work. Can support advanced digital services, including the ability to readily service ISDN at 160 kbps, with the use of ISDN DLC or switch cards. Uses DLC POTS line cards for large size remote terminals that will provide signaling and supervision out to 18 kft, and will meet dB loss requirements out to 17.6 kft. Uses DLC POTS line cards for small size remote terminals that are extended range cards capable of supporting copper distribution out to a maximum of 24 kft., although it places no analog copper loops longer than 18 kft.

Discussion: Adherence to the 18 year old CSA criteria is no longer required to meet the advanced services requirement. More efficient ways have been found to provide such services using better echo cancellation algorithms, digital signal processing, and other breakthroughs. As a result, telephone companies can provide ISDN services to anyone within 18 kft. of their serving central office.[4] It is also contradictory for BCPM3 to claim that

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[3] Report and Order in CC Docket 96-45 Adopted May 7, 1997. Released May 8, 1997 at Paragraph 250.

[4] "The DSL for ISDN Basic Rate Access (BRA) transmits 160 kbps in both directions simultaneously on a nonloaded cable pair." ... "Almost all loops designed to resistance design criteria, whether RRD or its predecessors, will transmit a DSL signal out to 18 kft." See, Bellcore, *Bellcore Notes on the Networks*, SR-2275 Issue 3, December 1997, pg. 7-71.

adherence to CSA guidelines is necessary to provide advanced services, when at the same time the BCPM3 fails to adhere to these guidelines.[5]

The provenance of BCPM3's claimed 900 ohm rule is also unclear. While it may be related to the BCPM3 proponents' argument that the DSC RPOTS DLC line card has a signaling and supervision limit of 900 ohms, this, too, is not correct, as per vendor specifications provided in Exhibit 11.

Although it is true that a real issue exists as to the dB loss associated with DLC line cards, BCPM3 misstates the facts, which are these. The DSC Litespan-2000 RPOTS cards utilized by both models employ a fixed 2 dB loss pad.[6] The RPOTS cards are, in fact, adequate to a distance of 17.6 kft. This is illustrated in Exhibit 12, which is an excerpt from the DSC Litespan-2000 practices. This exhibit shows that the copper loop distance available at 6.5 dB loss is 17.6 kft.[7] For those cases involving the rare circumstance of the last 400 ft. between 17.6 kft. and 18.0 kft. using DLC, the proper replacement for the RPOTS card is the RUVG2 card, which auto-adjusts between 8 dB loss and 1.6 dB gain.[8] The wrong choice would be to use the card normally reserved for unusual conditions involving special services for long loops in the embedded base, the REUVG card. The REUVG card is twice as expensive as the RPOTS card, and provides much more than necessary, including an auto adjusting loss/gain pad of 6 dB loss to 6 dB gain.[9]

A final issue is that of analog modem performance. The BCPM3 sponsors quote a technical paper by a Bellcore transmission engineer to indicate that service will be deficient on longer loops served off of DLC. Careful examination of the information presented in the Bellcore paper indicates

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[5] These guidelines state that the maximum length of 26 gauge cable can only be 9 kft., and the maximum length of 24, 22, or 19 gauge cable can only be 12 kft. See, Bellcore, *Bellcore Notes on the Networks*, SR-2275 Issue 3, December 1997, pg. 7-70. See also, Bellcore, *Telecommunication Transmission Engineering*, 3rd Edition, 1990, p. 94. BCPM3, however, specifies use of 26 gauge cable out to 12 kft., and use of 24 gauge out to 18 kft. and beyond.

[6] DSC Communications, OSP 363-205-110 *Narrowband Services Application Guide*, Issue 5A, December 1996, pg. 3-6. The reason for this loss pad is that the deployment of fiber fed DLC has so shortened the copper loop for distant subscribers that they complain of volume being too high.

[7] Although proponents of BCPM3 have claimed that loops should be designed for 6.0 dB of loss rather than 6.5 dB, this appears to be based on their neglect of the fact that the 0.5 dB of loss reserved for central office wiring losses in an 8.0 dB loop will not occur in an IDLC environment. See, "...the maximum insertion loss is limited to 8 dB (8.5 dB with office loss included)." Bellcore, Telecommunications Transmission Engineering, Vol. 3 pg. 103.

[8] DSC Communications, OSP 363-205-110 *Narrowband Services Application Guide*, Issue 5A, December 1996, pg. 3-19.

[9] DSC Communications, OSP 363-205-110 *Narrowband Services Application Guide*, Issue 5A, December 1996, pg. 3-24.

the variable nature of analog modem performance. The author very carefully qualifies his statements with comments such as the following:

"It may never be possible [to achieve 28,800 bps] depending on"

1) How each customer's service is provided to them.
2) How the network routes each call to the far end.
3) The Internet Service Provider's (ISP's) facilities will influence the overall data connection.
4) It will also depend on the modems that are being used (different manufacturer chip sets and varying modem quality levels).

Furthermore, it appears that the specific throughput tests that were performed to provide the data cited in the Bellcore study were not performed on loops engineered to the quality specifications adhered to by the loops in the HM 5.0 or the BCPM3.[10]

Score: BCPM3 centers its outside plant design on an antiquated planning concept which has been superseded by technological innovation. The model then violates its own concept rules, ignores vendor line card specifications, and chooses the most expensive special service line card when a less expensive alternative is recommended by the equipment vendor. HM 5.0 uses all applicable forward looking engineering guidelines and design specifications to design efficient facilities that work.

4. Switching

4.1. Forward-Looking Placement of Host, Remote and Standalone Switches

Issue: Because switching technologies have evolved over time, current configurations of switches as hosts, remotes or standalones may no longer be optimal. In particular, a wire center that currently houses two switches serving a total of 40,000 lines may, on a forward-looking basis, be more efficiently engineered with a single switch. Similarly, many small standalone switches could be replaced with more efficient remotes. To model efficient forward-looking costs, models must permit the placement of a switch type in a wire center that optimizes switching costs.

BCPM3: Requires use of current LERG-indicated status of switch counts by wire center, and configuration as hosts, remotes or standalones. Data are not provided that would permit the user to determine whether the remotes

[10] Conversation with author of Bellcore memo, 1/5/98.

modeled by the BCPM3 include the full range of remotes currently available, or whether only older, smaller remotes are modeled. Lines limitations for all switches appear to match only those associated with large 5ESS and DMS switches, and no check appears to be performed to determine whether a BCPM3-engineered remote could exceed a remote's lines capacity.

HM 5.0: HM 5.0 provides the flexibility to incorporate forward-looking, user-defined host/remote configurations. If information about such configurations is not available, HM 5.0 will default to modeling switches on a blended basis, assuming proportions of host/remote/standalone switch types that match the current blend of newly installed switches in average price per line.

Discussion: BCPM3 appears to be unable to operate without reference to the LERG's current specification of switch numbers and types. Thus, BCPM3 switching can only reflect embedded network configurations. This ensures that the switching costs modeled by BCPM3 cannot be forward looking.

There are several reasons why historical placements of hosts and remotes in the network reflect embedded technology, pricing, and engineering practices. Historical planning decisions would have placed remotes, hosts, and standalones based on a multitude of criteria that have changed over time.[11] For example, when remotes had a maximum capacity of approximately 2000 lines, a telephone company would probably have installed a small host or standalone switch or possibly two collocated remotes to serve 3500 lines. Today, remotes exist that can serve 5,000, 10,000, and even 20,000 lines.[12]

Concerns about inefficient modeling of switching costs if LERG placements are used as a base is not just a theoretical problem. It can easily be seen simply by examining LERG records for Bell Atlantic's 2055 L Street, NW wire center in Washington, DC.[13] The LERG currently shows two 1AESS switches, one DS? switch and 5ESS switch and 5ESS remote. It is likely that this remote was placed to provide certain advanced services (possibly ISDN or digital centrex) to customers served by this wire center that could not be provided by then existing 1AESS switches.

[11] Some of these criteria are: (1) lines demand of the area to be served and lines capacities of the equipment available at that time; (2) comparative prices of small standalones, remotes and digital loop carrier equipment available at that time; (3) life cycle costs, including maintenance and training of personnel associated with the equipment; (4) land and building and power availability; and (5) low penetration of Integrated DLC.
[12] In addition, modern DLC equipment has much larger line capacities than older generation technology. Thus, a truly forward-looking model would replace switches located in extremely small wire centers with a DLC remote terminal. This is not currently performed either by the BCPM3 or the HM 5.0.
[13] This happens to be the wire center that serves the FCC's downtown Washington, DC location.

BCPM3's LERG-based methodology would place either 5ESS or DMS switches in this wire center as substitutes for the 1AESS switches, *and* it would place a now superfluous 5ESS remote as well!

In addition, because the BCPM3 does not provide for the placement and costing of standalone switches smaller than the 5ESS or DMS-100 in size, it calculates extremely large per line costs for small wire centers that in the LERG are served by a small switch, such as a DMS-10.

Score: Because the BCPM3 uses embedded switch configurations, it is not a model of efficient, forward-looking switching cost. The HM 5.0 far more faithfully models efficient engineering of switches.

4.2. Use of Proprietary Models

Issue: The FNPRM has required that all submitted cost models be open, and subject to public scrutiny. Use of proprietary models to determine costs defeats this goal, and raises questions about the integrity of the modeling process for developing universal service costs.

BCPM3: Relies on either Bellcore's SCIS model or US West's SCM model to determine its switching costs. Although BCPM3 allows users to bypass this step and to directly enter switching prices, BCPM3 still relies on the proprietary algorithms and inputs to Bellcore's or US West's models to functionally categorize switching investment data into "buckets." In addition, BCPM's proprietary input models themselves require extensive data inputs that are unknown and undocumented

HM 5.0: HM 5.0 uses publicly available information for switching prices and does not rely on proprietary data. HM 5.0's inputs for developing switching costs may be entered directly out of contract information on prices paid by LECs for switches.

Discussion: Although the BCPM3's sponsors use the term ALSM for "Audited LEC Switching Module," for the SCIS or SCM input process to the BCPM3 switching module, these models are highly complex and extremely sensitive to *their* inputs.[14] Use of these models places a veil over practically all key stages of BCPM3's switching cost development.

[14] Note that the audit alluded to by the "A" in ALSM was performed in 1993 and is now stale. In BellSouth's cost filing in Florida Docket Nos. 960833-TP/960846-TP/960916-TP, Section 3 Description of Models and Price Calculators, BellSouth indicated that "In fact, technology, economic theory and other advancements are occurring at such a rapid pace that, approximately 35 to 40 percent of the system code must be revised on an annual basis." Thus, very little of the "audited" 1993 code likely remains in SCIS.

In addition, BCPM3's proprietary input models themselves require extensive data inputs that are unknown and undocumented. The functional categorization of outputs is highly dependent on the inputs entered by the BCPM sponsors into these models, yet none of this data has been made available.[15] A Bellcore SCIS expert testified[16] that there are 50 SCIS/MO setup inputs plus 22 setup inputs per technology, plus an additional 200 user specified office parameters for each host office and somewhat less for each remote office.[17] Unless each of these inputs is identified and made available for discussion and value determination during the input phase, BCPM3's functional categorization is suspect. Because of the sheer number of required inputs for each switch, this task may be impossible.

The sponsors have not included the SCIS or SCM models in the filing, nor have they documented the inputs used to run these models. Therefore, it cannot be determined if least-cost, most-efficient technology has been used in BCPM. There are numerous SCIS inputs that require decisions to be made regarding the type of technology and efficient engineering practices: for example, there is no reference to the amount, if any, of TR303-compliant integrated digital loop carrier used as inputs to these proprietary models.[18]

Score: The HM 5.0 is superior to the BCPM3 because its switching cost development is transparent. In contrast, the BCPM3 relies on unverified input models, and thus does not meet the FNPRM criteria.

4.3. Consistency of Input Values

Issue: Switching models may take data from different sources. These sources should provide data on a consistent basis with each other so that source-shopping is not used to manipulate results.

BCPM3: Relies on either Bellcore's SCIS model or US West's SCM model to determine its switching costs and bucketing of these costs.

[15] Indeed, the only data inputs identified by BCPM are those mentioned in passing in the Model Inputs Section of BCPM's Model Methodology. The BCPM sponsors indicate that the values used for BCPM inputs correspond to inputs used in SCIS, but their actual values were rounded because they are proprietary. The proprietary data they are protecting appear to be Calls per line and CCS per line – inputs that seem undeserving of proprietary treatment. No other data is documented, proprietary or not.

[16] Direct Testimony of David Garfield on behalf on BellSouth Telecommunications, Inc., April 30, 1997 before the Georgia Public Service Commission, Docket No. 7061-U, page 17.

[17] Some of these inputs are ISDN-related and would not be required here. Eliminating the ISDN inputs still leaves massive numbers of SCIS/MO inputs for each wire center.

[18] In addition, because the BCPM3 switching module is substantially delinked from its loop module, the amounts of TR303 DLC computed in the BCPM3 loop module are not used in the switching module.

HM 5.0: Uses publicly available information and data that are internally consistent.

Discussion: During the FCC review of the SCIS and SCM models in the ONA proceeding in 1993, it was determined that the models required separate examinations because of differences in their methodology. In particular, the differences between SCIS's and SCM's initial partitioning of switching equipment into functional categories is highlighted by BCPM3 in the discussion regarding Excess CCS being included in Usage or Port.[10] Given that the two proffered input models disagree in how a switch should be partitioned, it is unclear how a single set of functional categories can be created in BCPM3 without violating methodologies inherent in one or both input models. Thus, it appears quite possible that even if the total price of a switch were agreed upon, the functional categorization buckets could be radically different. Because neither the SCIS nor SCM models and their underlying methodologies are publicly documented, it is impossible to determine which input model is more correct.

Use of these proprietary input models also can make the cost results proprietary or inconsistent. Because the switch prices in the internal BCPM3 calculations require user-entry of proprietary discounts, this makes the model proprietary once these data are entered. The discount methodology incorporates the use of new switch and growth discounts to calculate the discount within BCPM, as well as an elaborate pre-processing of SCIS inputs/outputs to determine BCPM's perceived effective discount by functional category. In addition, if the SCIS or SCM results are used, rather than the BCPM internal calculations, these same category-specific discounts must be applied when running SCIS or SCM.

An additional source of inconsistency in the BCPM3 is its decision to eschew use of SS7 cost results produced by the SCIS model in favor of a user-adjustable constant investment term (BCPM, Release 3.0 Model Methodology, December 11, 1997, Section 7.4.3.1.2, p. 60). This choice of a SS7 cost number from outside of SCIS is especially curious given BCPM3's determination to use SCIS for all of its other switch investments.

Score: BCPM3 applies its input models in inconsistent mix and match configurations. HM 5.0 is superior due to its use of consistent configurations.

4.4. Validity of Modeled Cost Development

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[10] See, BCPM Switch Model Inputs documentation on Reserve CCS Inv. Per Line, Sections 1.28-1.31.

Issue: Within the open and operational modules of the cost model, the development of switching costs should be logically sound and accurate.

BCPM3: Uses a set of undocumented internal regression equations to convert switch cost inputs into output switching costs.

HM 5.0: Uses set of documented switch engineering rules and traffic equations to convert cost inputs into output switching costs.

Discussion: BCPM3's internal switch regressions are performed on any switch price inputs that do not come from SCIS or SCM to categorize functionally the switch investments. According to the BCPM3 documentation, these regressions were performed using independent explanatory variables.[20] To the contrary, these variables seem to be highly colinear, and thus will not accurately categorize total investment into more granular functional buckets. For example, two of these variables are lines and trunks. Although there are some minor variations, these two variables are closely linked.[21] Because the number of trunks will vary almost linearly with the number of lines, the regression's covariance matrix will be close to singular. Therefore, the regression formula is unlikely to differentiate reliably the amount of investment that is assigned to lines, versus the amount of investment assigned to trunks.[22] A similar issue exists with the colinear variables for calls per line and CCS per line.

In addition, these regressions were performed on list prices, even though BCPM3 states, in the same paragraph, that the impacts of discounting affect each functional category differently.[23] Thus, it appears that the BCPM3 regressions may have been performed on relative prices that BCPM3 states are inappropriate and irrelevant!

Score: The methodology used by BCPM3 to subdivide the investment into buckets appears to be extremely flawed. Thus, its "granular" results appear to be invalid. The methodology used in the HM 5.0 has already been subject to much scrutiny, and it has displayed appropriate adherence to accepted engineering norms.

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[20] BCPM 3.0 Model Methodology, Section 7.4.3.1.1, page 58-59.

[21] BCPM3 acknowledges this colinearity elsewhere when they provide a global input for number of lines per trunk as 14. See, BCPM Switch Model Inputs, Section 2.5

[22] The BCPM3 sponsors have not made available the statistics associated with their regressions to permit verification of these suspicions. Furthermore, BCPM3 claims to have used SCIS and SCM outputs from a sample of switches to derive the switch curve. This data set has not been provided with the BCPM3, and there is no documentation of how the sample was derived. Without access to the details surrounding the sampling process that generated these underlying data, their validity is undemonstrated and doubtful.

[23] BCPM 3.0 Model Methodology, Section 7.4.3.1.2., page 60.

4.5. Cost Allocation Issues

Issue: For switching costs to be reliable, they must be associated correctly with their cost drivers.

BCPM3: BCPM3 assigns the entire fixed, start-up cost of the switch as "processor-related." BCPM3 also allocates individual functional categories of hosts and remotes differently. For example, if a remote is attached to a host, but belongs to a different rate center, BCPM excludes that remote for allocating the host's "processor" (i.e., the one-time fixed start-up cost). The BCPM Model Methodology section 7.3.3.1 describes that an interface module typically provides one speech line for every two to six line terminations.

HM 5.0: Hatfield correctly models the entire host/remote complex and allocates all the investments and expenses evenly over all host/remote lines. This methodology ensures that all engineering cost efficiencies associated with the complex equally benefits all subscribers in the complex.

Discussion: BCPM3's assignment of all start up costs to the processor category appears to have as its purpose the inflation of vertical features costs.[24] The processor, in actuality, is a minor percentage of these costs, with the majority attributable to one-time fixed start-up costs.

BCPM3's line to trunk ratio is incorrect. The ratio of speech links to line terminations is called the Line Concentration Ratio. One speech link for every two line terminations would require the equipment to be "deloaded" in some switches and would be done only in limited circumstances for exceptionally high traffic requirements. Line termination ratios are provided by the vendors up to 10:1, not 6:1 as shown in BCPM3's description. The lower the line concentration ratio, the more investment and equipment is purchased to service the demand. If BCPM3 has artificially limited the line concentration ratio to 6:1, then substantially more equipment and cost has been included in BCPM than is required for a most-efficient engineering configuration. Six and eight line terminations per speech link are the most common.

[24] To justify large separate charges for individual features of the switch, a way must be found to "usage-sensitize" the switch in a fashion that assigns substantial switch investments to features. This could be accomplished by allocating costs of processor usage based on features. By associating all of the fixed start-up costs of the switch with its processor, the cost of processor usage (from which feature costs are derived) is inflated many times over. In actuality, since the processor is purchased as part of the one-time, start-up cost of the switch, there is no cost-causation basis to assign any of its investment to usage-sensitive features.

The SCIS investment category, called terminating call, has been assigned to the trunk functional bucket in BCPM3. This is incorrect, as the terminating call cost is associated with every terminating call on the line, whether an intraoffice or interoffice call.

Score: Allocation of costs is more consistent and logical in the HM 5.0.

5. INTEROFFICE TRANSPORT

See attached sheets

6. Signaling

7. See attached sheets

BCPM3 DISTRIBUTION CABLE CALCULATIONS

The distribution architecture used by BCPM3 to serve the customers that it assumes are along "roads," but that its data input process relocates to a "road-reduced square" located at the grid's (or gird quadrant's) road centroid inappropriate. This is demonstrated in the attached Exhibit 1 Many customers, particularly in rural areas, actually are located linearly along roads, as opposed to being located in a "tract" arrangement of parallel and closely spaced streets. While it is appropriate to model the distribution architecture for serving housing tracts with the backbone and branch arrangement shown in the upper right of the figure, it is inappropriate to do the same for rural customers located along roads. They should be served by a cable running down the road, as shown at the bottom right of the Exhibit 1.

It is highly unlikely that approximating the linear configuration shown at the lower right by the two-dimensional arrangement shown at the upper right, which BCPM3 does, can lead to the right result. As the attached Exhibit 2 demonstrates, whether the BCPM3 places the correct amount of cable (using its required backbone and branch layout) to customers located along roads in rural areas, is completely hit or miss.

BCPM3 TRANSPORT CALCULATIONS[1]

The BCPM3 Does Not Model a Forward-Looking Network

The BCPM3 transport calculations attempt to replicate the basic structure of the LECs' embedded interoffice network. As the BCPM3 developers state, their model "utilize[s] actual data on remote-host-tandem switch homing relationships" to form the basis for its assignment of wire centers to rings.[2] Indeed, users must execute a separate licensing agreement with Bellcore to obtain the information needed for the BCPM3 to operate at all.

Using the LERG to replicate existing local telephone network structures results in network configurations and costs that are not forward-looking. The architecture and technologies employed in embedded networks have evolved over many decades, and, as a result:

1. may include more tandem locations than would be modeled in a forward-looking design;
2. LERG host-remote relationships may not be forward-looking, because a forward looking design would not necessarily place remotes in locations where they currently exist;[3]
3. switches now operating as standalone machines might become remotes or hosts in a forward-looking design; and
4. in a forward-looking architecture remotes may not be assigned to the hosts that now serve them.

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[1] Because previous versions of the BCPM have contained no explicit modeling of the interoffice transport and signaling network, the transport module included with the BCPM3 is the developers' first public effort in this regard. As such, it displays infirmities that are typical of "first efforts." These include sparse, and sometimes inconsistent documentation, and numerous shortcuts or errors in interoffice network logic. It is quite likely that the BCPM3 sponsors are aware of many of these shortcuts or errors, and are attempting to cure them. Since AT&T and MCI have no alternative sources of information about the BCPM3's current operations or prospective corrections beyond what is provided in the several pages of outline documentation that accompany the BCPM3, the comments provided herein are based AT&T and MCI's best understanding. If the BCPM3 actually operates in a fashion different from indicated in the documentation, or if any errors described in these comments have been cured, AT&T and MCI would be happy to reevaluate or rescind their concerns.

[2] BCPM 3.0 Model Methodology at 67

[3] The LERG describes many wire centers in which a remote is collocated with standalone and host switches. A typical example is that of a Lucent 5ESS remote installed next to an analog Western Electric 1AESS -- most likely to provide ISDN or other advanced services not available on the 1AESS. Such a multiple technology deployment is not efficient on a forward looking basis. Indeed, because the BCPM3 places separate rings to serve host-remote links, and to serve host-standalone-tandem links, BCPM3 would engineer *two* separate rings to serve any LERG wire center that contains both a remote and a standalone switch.

BCPM3's reliance on the current network architecture in its transport calculations appears likely to produce cost estimates that are based on suboptimal network design.

The BCPM3 also does not use forward-looking cross connect technology in its transport calculations. Modern networks normally use digital cross connect systems which allow reliable automated assignment of DS-0s to DS-1s, DS-1s to DS-3s, and sometimes higher-level assignments. In the past, such assignments were made using manual cross connects, called DSX panels that employ jumper cables and patch panels to effect the physical rearrangement of connections necessary to assign a trunk to a specific transmission facility. While such panels are cheap to purchase, they require much expensive labor to manipulate their connections. The connections themselves, being mechanical, are inherently unreliable, and the manual nature of the assignment process can lead to misplaced connections. For these reasons, it is standard current practice for LECs to install automated digital cross connects at the nodes of their transport networks. BCPM3 contains no investment inputs for digital cross connects, and apparently relies on antiquated manual cross connect technology for DS-1 and DS-3 assignments.[4] Note, too, that since use of digital cross connects is common in current LEC networks, to the extent that the BCPM3 bases its transport support expenses on recent LEC experience, there is likely a mismatch between expenses and investments.

The BCPM3 Transport Modeling Has Other Infirmities

In general, lack of documentation of the model's algorithms makes the BCPM3 transport calculations difficult to examine, however, a few inferences may be drawn:

1. The model apparently populates rings with wire centers operated by different operating companies, thus forming multi-company rings. This is at odds with accepted practices.

2. The model attempts to equalize the number of nodes on the rings so that all rings contain about the same number of nodes.[5] This exercise is unlikely to result in optimized node configurations.

3. No investments appear to be computed for inter-ring connections or inter-tandem connections. The only point of interconnection between rings is at the tandem in the case of host-standalone-tandem rings, or the host in the case of host-remote rings. This is an unreliable network configuration in that a single point of failure at the tandem switch would cause all inter-ring communications to cease. Because no inter-tandem connections are engineered, only traffic transiting a

[4] "The appropriate termination equipment components are selected from the following list: Fiber Tip Cable, Fiber Patch Panel, Fiber Optic Terminal, DS3 Card, DS1 Card, OC3 Card, *DSX3 Cross Connect, DSX1 Cross Connect, DSX1 Cross Connect Jack Field*, Channel Bank and Channel Bank Card." See, BCPM 3.0 Model Methodology at 74, [emphasis added].

[5] Although the BCPM3 sponsors claim that users may specify a limit for the number of nodes constituting a ring, (BCPM 3.0 Model Methodology at 69), tracing the user input ("Manual Inputs" worksheet, cell C5) for this factor appears to indicate that this input parameter is not used in the model's calculations.

single tandem is supported by the model. This would appear to preclude the provision of complete intraLATA toll services in many LATAs.[6]

4. The transport and switching modules also appear to operate independently. In the transport module, for example, the model relies on a single line-to-trunk ratio to estimate the number of trunks serving each switch. Given that the BCPM3 switching module purports to traffic engineer the number of trunks required at *each* switch according to that switch's particular residence and business line mix and its per-line traffic characteristics, it is curious that this information is not passed to the transport module for sizing transport facilities. Use of a single ratio of lines to trunks for all switches will lead to an overstatement of the number of trunks required for large switches or switches that serve predominantly residential areas, and an understatement of trunks required for small switches or switches serving business areas.

5. The transport module also relies on a single ratio to determine the number of special access lines as a fraction of total lines in wire center. This, and all other inputs, except for wire-center-specific lines counts (if available), appear to apply identically to all LECs in a state, and are not specific to any particular urban LEC or rural LEC.

6. The ability of the BCPM3 ring-finding algorithm to identify optimal rings is suspect. First, it apparently seeks to optimize the difference in <u>ring</u> cost when a given wire center is added to the ring versus the wire center not being on the ring -- rather than optimizing the more appropriate cost savings function that would compare the <u>wire center</u> cost if directly connected to the tandem vs. joining a ring. The latter is more appropriate because it is the cost of linking all nodes to the tandem that should be minimized, not the cost of any particular link. Second, it appears that <u>all</u> nodes end up belonging to a ring. This is not always the most optimum arrangement – for instance, if all wire centers but one are geographically clustered on one side of the tandem and the remaining wire center is on the other side, it may be more efficient for this isolated wire center to have its own redundant point-to-point link ("folded ring") to the tandem, rather than being part of a ring involving any of the other wire centers. Third, requiring the tandem to be a node on every ring can be a highly inefficient arrangement, as Exhibits 13 and 14 demonstrate. In an area where a single tandem serves a stretched out geography, such as the case in Colorado in which a tandem in Denver serves the entire "front range" from Colorado Springs to Fort Collins, requiring every ring to reach back to the tandem causes a very large, and unnecessary, amount of ring distance. By contrast, appropriately interconnecting local rings by a secondary ring, creating a "ring of rings" configuration, or providing point-to-point links between rings, leads to many fewer ring miles.

[6] Note that with efficient placement of tandems, this failure to provide complete intraLATA toll or access capability would occur only in large LATAs – but because the BCPM3 uses embedded LERG data that provide for multiple tandem placements in many LATAs, the problem is much more widespread.

BCPM3 Signaling Calculations

Review of the signaling network calculations contained within BCPM3 indicates that no explicit modeling of signaling costs is performed at this time. Instead, the user must employ an input table that is based on results produced by the "Signaling Cost Proxy Module" for parts of U S WEST's operating region.[7]

Given the reliance of BCPM3's transport module on the LERG, it appears likely that when a BCPM3 signaling module is produced, it too would rely on existing LERG relationships to reproduce signaling costs for the embedded network. The BCPM3 sponsors presage such a result through their statement that the module "[u]ses the existing SS7 signaling network as the basis for the SCPM network."[8] Any modeling of the embedded signaling network causes similar disconnects with the requirement that cost modeling be forward-looking as occur with BCPM3's LERG-based transport calculations.

Use of the LERG also suggests that the potential BCPM3 signaling module would construct a two-level network (i.e., the network consists of two levels of STPs). Two-level signaling networks are not needed for local service. Indeed, the most likely use for a second level of STPs is to provide signaling for interexchange services across a multiple LATA region.

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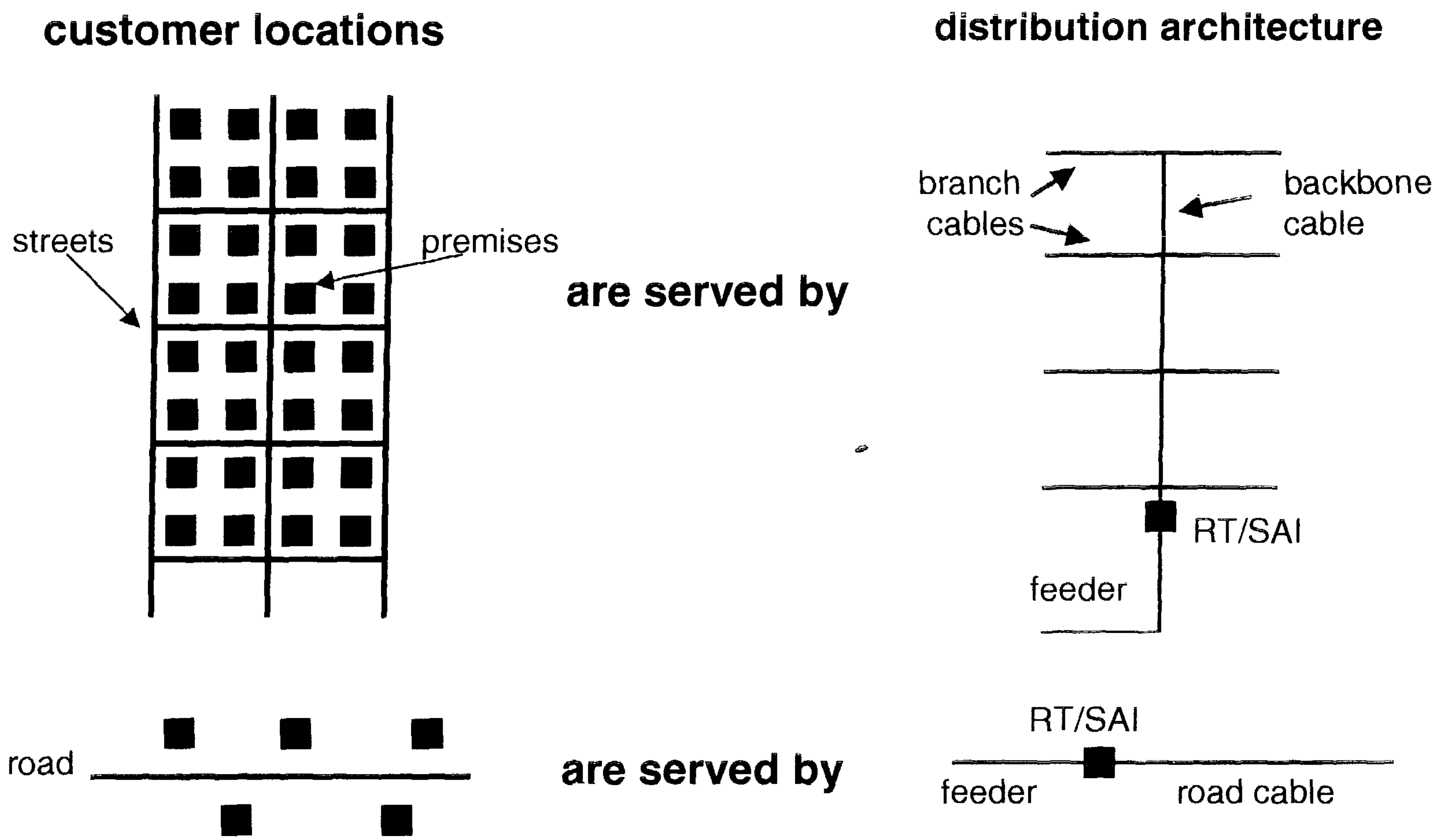
[7] *BCPM 3.0 Model Methodology* at 76.

[8] *id.*

Figure 1



Customer Locations and Distribution Architectures